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its eyes and brain, etc., never formed out of old tissue, but always from new tissues.

In one case two heads formed on opposite sides of a short cross-piece that had been cut from the middle of the body. The head, therefore, had the normal orientation of the piece, while the other, turned in the opposite direction, had its orientation exactly reversed.

*Regeneration and Grafting in Cordylophora.*

G. LEFEVRE. (Presented by E. A. Andrews.)

THE stems of *Cordylophora*, when cut in pieces, exhibit the heteromorphic formation of hydranths, as has already been observed in this hydroid.

The cœnosarc regenerates the new hydranth at the cut end by a distinct process of budding, growing out beyond the old perisarc into a knob-like projection which acquires the rudiments of tentacles in from 36 to 48 hours. This is not merely a direct transformation of the tissues of the stem into the body portion of the hydranth unaccompanied by growth, as has been described for other Tubularian hydroids, but the process is in truth a regeneration or new formation.

A piece of stem invariably regenerates a new hydranth at each end, even when lying on the bottom of a dish. Usually a foot is formed when a stem is brought in contact with a solid object, but in several cases it was found that a hydranth arose at the end which was firmly attached to the dish, the hypostome acting as the organ of attachment. This inverted hydranth did not attain to complete development, but it was a distinct hydranth provided with several short tentacles.

Only negative results were obtained from isolated tentacles, as no regeneration took place, the tentacle soon contracting into a rounded mass and dying.

Grafting may be successfully performed

on the stems of *Cordylophora*. When freshly cut pieces are brought into contact, end to end, a firm, complete, permanent union takes place. Ectoderm unites with ectoderm, endoderm with endoderm. There is no polar differentiation in regard to the ability of the stems to fuse with each other, and in the experiments which were made, series of fused pieces were obtained representing all the possible combinations of the two poles. The united stems did not eventually break apart, but remained intact until they finally died *in toto* after several days. At the point of union between two pieces a lateral branch was given off in many cases, each portion apparently contributing equally to the branch.

*A Recent Variety of the Flatfish, and its Bearing upon the Question of Discontinuous Variation.* H. C. BUMPUS.

It was shown that within the past five or six years the lower side of the flatfishes (*Pleuronectes Americanus*) from Woods Holl, Narragansett Bay and Long Island Sound has, with great frequency, become deeply pigmented over more or less definite tracts.

The abrupt appearance of a large number of individuals, varying in a definite direction, bears directly upon many current speculations of organic evolution. It was claimed that the variation being so widespread must have been the result of some environmental stimulus upon the germ, since the arrangement of the color precludes the possibility of its being the result of the direct action of light, and there is evidence to prove that the appearance of 'piebald' specimens was not due to the invasion of piebald fish from other localities.

It was also claimed that the process of natural selection could not have been materially instrumental, since the presence of the piebald specimens was first indicated by a large number of young fish, and because the time has been too brief for nat-

ural selection to eliminate either the original type or the new variety. It would, moreover, be illogical to presume that the same agent that has been instrumental in causing the disappearance of the pigment in the natural fish is the same agent, in the same locality, and under apparently the same conditions, that is instrumental in again producing pigment on the lower side.

*A Precise Criterion of Species.* C. B. DAVENPORT.

IN order to decide whether two allied groups are species or varieties it is necessary first to give an exact quantitative expression to the two best criteria of species—divergence and segregation—by the use of the modern mathematical method of studying individual variation. Divergence is the distance between the modes of the two groups in question expressed in units of the average deviation from the mean of the individuals of one of the groups. Segregation is inversely proportional to the number of intergrades, or it is the height of the lowest ordinate between the two modes expressed in units of the height of one of the modes.

An examination of the usage of systematists will tell us what least degree of divergence or segregation is usually expected in distinct species. Leaving the precise determination of this least degree still undecided, we may conclude: A group of allied individuals giving a dimorphic curve of a (differential) character consists of two species either when the minimum between the two groups is  $m$  [20] % or less, of the shorter mode, or when their modes diverge by  $n$  [10?] or more times the smaller average deviation of the two subgroups. Otherwise the dimorphic curve indicates two races.

*Certain Results from a Study of the Variation of Littorina.* H. C. BUMPUS.

THE critical study of variation in 100

specimens of *Necturus* revealed the fact that those individuals which were abnormal so far as location of the pelvis was concerned were also abnormal in respect to many others, and only remotely related characters; that those individuals which were unstable in respect to one character tended towards instability in respect to all characters; that variation of one organ was an indication of probable variation of other, if not of all, organs. The examination of over 1,700 sparrows' eggs encouraged the belief that this principle of the general instability of variants might be of further application, and in a recent article by Havelock Ellis, on Genius and Stature, it is concluded, on anthropological data alone, that those variations of mind which have been instrumental in producing men of eminence are accompanied by striking and remote physical variations; that those who have attained distinction as warriors, statesmen, scientists or writers have generally been above or below the mean of stature.

The speaker then exhibited 1,000 shells of *Littorina littorea* which had been arranged in order, according to their shape, from extreme elongation to extreme ventricosity, and showed that those at the extremes tended toward excessive variation in weight. Both ventricose and elongated shells were far heavier and lighter than the species of more ordinary form.

*Grafting Experiments on Tadpoles, with Special Reference to the Study of the Growth and Regeneration of the Tail.* R. G. HARRISON.

THE method of grafting amphibian larvæ, as described by Born in his exceedingly original and suggestive paper [Archiv f. Entwicklungsmechanik, Bd. 4], may be applied to the study of the normal growth of the embryo. Thus, when portions of larvæ of *Rana virescens* and *R. palustris* are combined in various ways to form a complete normal organism, the sharp con-